

VEGETATIVE APOMIXIS IN *MUHLENBERGIA REPENS* (POACEAE: ERAGROSTIDEAE)

CLIFFORD W. MORDEN and STEPHAN L. HATCH

*S. M. Tracy Herbarium, Department of Range Science
Texas A&M University, College Station, TX 77843, U.S.A.*

Vegetative apomixis in grasses refers to the production of bulbils (a small bulb or bulblike structure produced on above ground parts, Radford et al. 1974, p. 92) in flowers by modification of spikelet structures (lemma, palea, androecium, and/or gynoecium). The term "vivipary", which is the germination of a seed within the flower (Stebbins 1941), has often been misapplied to describe this phenomenon (Nygren 1954, Gould 1968). Vegetative apomixis is known to occur in the families Agavaceae, Liliaceae, Poaceae, Polygonaceae, and Saxifragaceae. In grasses, it is most commonly associated with the tribes Poeae (*Poa* and *Festuca*) and Aveneae (*Deschampsia* and *Agrostis*). However, it has also been described in the Chlorideae for *Bouteloua* (Hill 1982), the Eragrostideae for *Eleusine* (Nygren 1954), and in the Paniceae for *Setaria* (Nygren 1954). This condition has been previously mentioned in the Eragrostideae for *Muhlenbergia richardsonis* (Trin.) Rydb. (Cronquist et al. 1977) although not described. In the course of field collections, three populations of *M. repens* (Presl) Hitchc. were collected that had spikelets exhibiting vegetative apomixis. Two of these populations were separated by approximately 50 kilometers and disjunct from the third by approximately 600 kilometers. Collection data for the specimens are given in Table 1. Following is a description of the spikelet parts of the three populations.

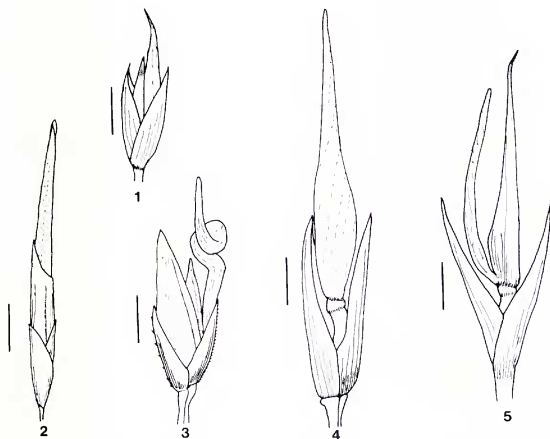
Spikelet structures of non-apomictic spikelets have glumes 1.6–2.4 mm long, lemmas 2.6–3.2 mm long, and paleas 2.1–2.7 mm long (Fig. 1). The vegetative apomictic specimens of Morden et al. 518 have spikelets with dimensions that are average for the species (Figs. 2 and 3). The rachillas of these spikelets are not elongated. The androecia and gynoecia are modified into bulbils and the leaf of the bulbil either extends out the top of the spikelet between the lemma and palea, or grows through the palea and curves upward, usually twisting.

The production of bulbils in Morden et al. 521 and Morden 684 is similar to that of population 518. However, the appearance of these spikelets are greatly modified. The glumes are greater than 3 mm long (longer than many sexual spikelets). The rachilla is also elongated, in most cases 1–2

mm long, resulting in the floret being exposed well above the glumes. The lemma is elongated to 5 mm or more in length and the palea appears to be absent or modified forming the outer leaf of the developing bulbil. The appearance of the bulbil in other respects is similar to that previously described.

Vegetative apomixis in these populations was not present in all spikelets of the inflorescence. Apomictic conditions are usually limited to several spikelets within an inflorescence and only a few individuals from each population.

There are several postulations as to why vegetative apomixis develops in populations. There is a strong correlation between the presence of this condition and the ploidy level of the species involved such that as ploidy level



Figs. 1—5. Vegetative apomixis in *Muhlenbergia repens*. 1. A non-vegetative apomictic spikelet of *M. repens* with average spikelet dimensions (Morden *et al.* 521). 2. Vegetative apomictic spikelet with the leaf of the bulbil extending out the top of the spikelet (Morden *et al.* 518). 3. Vegetative apomictic spikelet with the leaf of the bulbil extending through the palea and upwards (Morden *et al.* 518). 4. Vegetative apomictic spikelet with elongated glumes, rachilla, and lemma. Bulbil is not evident (Morden 684). 5. Vegetative apomictic spikelet with elongated glumes, rachilla, and lemma. Bulbil is extending through the palea and upward (Morden *et al.* 521).

TABLE 1. Collection data for vegetative apomictic populations in *Muhlenbergia repens*. Specimens are deposited at TAES.

MEXICO. NUEVO LEON. Scattered patches along hillside, 8 km W of "Y" intersection in Galeana, 1740 m elev., 27 Aug 1981, *Morden, Hatch, & Valdes R. 518*; in low areas along Hwy 57, 32 km N of San Roberto, 18 km S of San Rafael, small patch associated with *M. utilis* and *M. villiflora*, 1740 m elev., 27 Aug 1981, *Morden, Hatch, & Valdes R. 521*. UNITED STATES. TEXAS. Jeff Davis Co.: 17 mi S of Kent in canyon along Hwy 118, 1730 m elev., 13 Oct 1982, *Morden 684*.

increases, vegetative apomixis becomes more prevalent (Stebbins 1941, Nygren 1954). This is found either within a single species with various ploidy levels or within a genus. In his work on *Deschampsia*, Nygren (1954) found vegetative apomixis to be caused by a single recessive gene. Nygren also reported that for *Poa alpina* this condition was either gene related or environmentally stimulated. Because of the presence of two such distinct morphological forms, we feel that vegetative apomixis in *Muhlenbergia repens* is the result of two independent evolutionary occurrences. Since it is seldom found in natural populations, it is possibly the result of a recessive gene that is prompted by environmental stimulation resulting in a low frequency of occurrence in the population.

Another means by which this may have become incorporated into *M. repens* is through hybridization. *Muhlenbergia richardsonis* is closely related to *M. repens* and independent studies by the first author have shown there to be intergradation of morphological characteristics in eastern Arizona and western New Mexico where the two species overlap in distribution. It is possible that genes carrying traits for vegetative apomixis were passed from one species to the other and introgressed into the other populations. This process could have happened in either direction. However, it does not seem likely because of the two differing morphological types.

ACKNOWLEDGEMENTS

This is a technical bulletin T.A. No. 20969 of the Texas Agricultural Experiment Station. Thanks are extended to Sigma Xi, the Scientific Research Society for partial financial support for this study. Appreciation is expressed for the constructive remarks of Kevin Jensen, Chuck Coffey, K. N. Gandhi and two anonymous reviewers of the manuscript.

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